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BERMAN H S		
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DAVIS J G		
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DUNI B		
FARMAN L K		
FEALY T J		
FEDAHL T		
GLBIG J G		
GRBY W A		
HESTER A W		
HANN H P	X	X
HARX G E	X	
HODONALD M M		
HOKENNA F G		
HONTROSE J K		
HORGAN R V		
HOTTER G L		
IZZUTO V M		
LEY J H		
LSING T L		
MANDLIN N B		
METLOCK G H		
NEWART D L		
OLLIVAN M		
WANSON E R		
TLKINSON R B	X	X
WILLIAMS S (ORC)		
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August 31, 1993

93-RF-10580

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Attn R J Schassburger

ENVIRONMENTAL DATA ANALYSIS AND STORAGE-DETECTION LIMIT ISSUES - NMH-437-93

Ref (a) J K Hartman ltr (6508) to R L Benedetti, Environmental Data Analysis and Storage, June 9, 1993

(b) R L Benedetti ltr, 93-RF-7949, to J K Hartman, Environmental Data Analysis and Storage, June 28, 1993

This letter reports on the progress EG&G has made to date on formulating a policy for handling chemical analysis data sets containing reports as non-detects (Ref a) Significant progress has been made, however, additional investigation will be necessary to develop a policy that is technically sound, permits the Department of Energy the maximum flexibility yet consistency over the entire Interagency Agreement implementation course, and is cost-effective As a result, in distinction from our original response date of September 1, 1993 (Ref b), EG&G proposes a revised date of October 25, 1993 for reporting on this task This extension will permit EG&G to (1) obtain and utilize additional specialized resources and, (2) take advantage of discussions with the agencies regarding statistical analysis of data and data aggregation occurring through September and October while the "stop work" issues are addressed

Some significant findings identified through our efforts include

1) When data sets have high non-detection rates, simple substitution of values at 1/2 the detection limit, according to standard Environmental Protection Agency guidance, leads to very different estimates of the mean and upper confidence limit (UCL) when contrasted with a distributional Maximum Likelihood Estimation (MLE) procedure This is illustrated in Table 1 (attached)

   - At a high non-detection rate (i e , Thallium 98%), the difference in estimates of the mean differs by a factor of 10 (0 5 vs 5 5) and the 95% UCL estimates differ by a factor of 6 (1 0 vs 6 1) In this case, simple substitution provides a mean estimate 10 times higher than the MLE approach
   - At a non-detection rate of 50% (Antimony), both the MLE and simple substitution estimates are essentially equal (means= 39 4 and 39 0 UCL 95% = 45 7 and 43 7)
   - At low non-detection rates (i e , Zinc, 5 2%), both the MLE and simple substitution estimates are again essentially equal (means= 23 3 and 23 3, UCL 95% = 28 3 and 28 1)

This result initially suggests that different methods of estimation would be appropriate depending on the non-detection rate However, it also surfaces more in-depth considerations such as

- Should low detection frequency reports (i e , high non-detection rate) even be subjected to analysis or should they be eliminated administratively?
- What basis needs to be advanced for the agencies to accept administrative elimination?

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- Is the log normal MLE appropriate considering that other distributions can be employed? What technical basis needs to be advanced to substantiate any MLE distribution (e g , log normal, normal, Weibull, etc) employed, and could one convince the regulators and public of its veracity?
- What are the programmatic cost and schedule impacts of employing a method (or battery of methods) more sophisticated than simple substitution (e g , MLE estimation) and what are the technical gains considering all uncertainties in the risk and remediation analysis?

Also, analysis from which Table 1 (OU 1 groundwater monitoring data) was culled indicated significant numeric differences in the type of mean estimated when arithmetic and geometric methods were employed In general, geometric means were nearly a factor of two lower than the value of the corresponding arithmetic means

2) Revision of the OU 1 RCRA Facilities Investigation/Remedial Investigation (RFI/RI) Human Health Risk Assessment (HHRA) indicates that estimation methods used for non-detection reports can have significant impact on findings The Draft report, submitted October 1992, employed an extrapolation method for handling multiple detection limits [the method known as Multiple Detection Limits (MDL) is advanced by Helsel, 1990] In response to criticism from the agencies for inconsistency, for the final HHRA (currently in EG&G review) simple substitution using 1/2 the Contract Required Detection Limit (CRQL) was employed The resulting groundwater related risk estimates appear to be approximately five to seven times higher in the final HHRA owing to this difference in treatment of non-detection reports

3) Several other significant points which have surfaced during our work on this issue are
   - Use of EPA Region VIII guidance to delete, on administrative grounds, non-detect reports that exceed twice the CRQL (i e , the "Gansecki Rule")
   - The occurrence of artificial data created by contractual conditions in laboratory reporting of non-detects (a common problem in the EPA's Contract Laboratory Program) wherein data reported are completely an artifact of the reporting requirements

Based on the above and related observations, it is apparent that a uniform policy for handing data sets containing non-detection reports will require additional analysis This analysis will advance the technical aspects reported above using Rocky Flats Plant data and will also focus additional effort on the programmatic and administrative aspects of such an influential policy Because this issue can impact HHRA findings, it is important to consolidate it into current discussions being carried out under the current "stop work" order If you have any questions or concerns, please contact D M Smith of Environmental Engineering & Technology at extension 8636

N M Hutchins
Acting Associate General Manager
Environmental Restoration Management
EG&G Rocky Flats, Inc

DMS cet

Orig and 1 cc - J K Hartman

Attachment
As Stated

cc
A H Pauole - DOE, RFO

Table 1
Influence of % Nondetect
on Exposure Parameter Estimates

MLE vs Simple Substitution

Values= ug/l

Compound	% Nondetect	Log Normal MLE Mean	Log Normal MLE UCL 95%	Log Normal 1/2 DL Substation Mean	Log Normal 1/2 DL Substation UCL 95%
Thallium	98%	0 5	1 0	5 5	6 1
Arsenic	79%	2 6	3 2	4 7	5 2
Antimony	50%	39 4	45 7	39 0	43 7
Chromium	14%	75 4	116 7	72 1	107 5
Zinc	5 2%	23 3	28 3	23 3	28 1

Data from OU 1 groundwater monitoring Sample sizes range up to 150 reports

The population Mean and Upper 95% Upper Confidence Limit (UCL 95%) are standard exposure estimation parameters for risk analysis

MLE. Maximum Likelihood Estimate, a distributional estimation method discussed by Helsel, 1990, (*Less Than Obvious, Statistical Treatment of Data Below the Detection Limit*, Environmental Science & Technology, Vol 24, No 12)

Simple substitution at 1/2 the detection limit for non-detect reports is standard EPA guidance (*Risk Assessment for Superfund*, EPA/540/1-89/002, 1989)